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INTER-STORE EXTERNALITIES AND THE EFFICIENT ALLOCATION OF A COMMERCIAL CENTER SPACE

The case of Sonae Sierra

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MANAGEMENT

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ABSTRACT

This thesis analyzes the complex problem of an efficient space allocation in shopping centers in the presence of inter-store externalities. In doing so, we exploit a comprehensive and unique dataset extending for a period of three consecutive years, to confirm that anchors generate positive externalities by increasing the sales of non-anchor stores and, in turn, non-anchor stores pay for those benefits through higher rents. Taking this into account, the developer should allocate space to the various stores in order to maximize the center turnover and retailer profits. The carried out empirical analysis shows that, on average, anchor stores have more space provided, higher volume of sales, and lower rents to pay. Specifically, 'restaurant' and 'cinema' types of anchors contribute to an increase on non-anchor sales and, simultaneously, the former also provides an increase on non-anchor stores rent. These findings have strong practical implications for the design of a commercial center space.

Keywords: Externalities, Anchor Stores, Commercial Center, Space Allocation

JEL: C33, D62

RESUMO

Esta tese analisa o complexo problema de uma eficiente alocação de espaço em centros comerciais na presença de externalidades. Para tal, utilizamos uma extensa base de dados, única e abrangendo um período de 3 anos consecutivos, para confirmar que as lojas âncora geram externalidades positivas, aumentando as vendas das lojas não-âncora e, por sua vez, que estas pagam esses benefícios através de valores de renda mais elevados. Tendo isto em conta, o promotor do centro comercial deve alocar espaço às várias lojas com o intuito de maximizar o volume de negócios do centro e o lucro das lojas. A análise empírica realizada mostra que, em média, as lojas âncora têm mais espaço disponível, um maior volume de vendas e rendas mais baixas. Especificamente, as lojas âncora do tipo “restaurante” e “cinema” contribuem para um aumento das vendas das lojas não-âncora e, simultaneamente, o primeiro contribui ainda para um aumento da renda das lojas não-âncora. Estes resultados têm uma forte implicação prática na política de alocação de espaço de um centro comercial.

Palavras-Chave: Externalidades, Lojas Âncora, Centro Comercial, Alocação de Espaço

JEL: C33, D62

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1 INTRODUCTION

"A given number of stores dealing in the same time merchandise
will do more business if they are located adjacent or in proximity to each other
than if they are widely scattered"
Richard Nelson

The impact of commercial centers in modern economics and lifestyles is well established: just to give an example, in 2007, malls account for around 14% of all US retailing, about $308 billion in annual sales, slightly more than half of what people did in malls was unrelated to actual shopping – eating, movies, games, hanging out, socializing, and so on (Yiu, 2007).

The term 'shopping center' has been evolving since the early 1950s. Following Cushman and Wakefield (2009: 1), we define it as "a centrally managed, purpose built facility with a gross livable area of over 5,000m^2 and comprising more than 10 retail units. Factory outlets and retail parks are excluded". In a somewhat similar vein, the ICSC[1] (1999) defines 'shopping center' as a group of retail and other commercial service providers that is planned, developed, owned and managed as a single property. On-site parking is provided and the center's size and orientation are generally determined by the market characteristics of the trade area served by the center.

Taken together, this concept assumes the simultaneous existence of a number of characteristics: spatial integration of establishments, unitary management and shared services, adaptation of the commercial project to the specific nature of the target population, diversity in the trade mix and the presence of anchor stores, extended opening hours common to all installed units, and availability of car parking facilities.

However, due to the maturity of the industry, numerous types of centers currently exist that go beyond the standard definitions. The ICSC (1999) has already defined eight main shopping center types based on size, age, number and type of anchors, as well as the trade area: Neighborhood Center, Community Center, Regional Center, Superregional Center, Fashion/Specialty Center, Power Center, Theme/Festival Center, and Outlet Center.

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[1] International Council of Shopping Centers

Implicit in shopping center definition are the concepts of retail agglomeration and inter-store externalities. Underlying the concept of agglomeration economies – defined as the benefits ensuing from clustering of economic activity, in this case, retail stores – is the reduction in consumer search and uncertainty costs (Des Rosiers *et al.*, 2009). Besides, the agglomeration of a large number of stores together under the same roof also provides higher competition and easier price comparison (Yiu, 2007). In turn, retailers can enjoy high levels of customer traffic and large sales volume (Brueckner, 1993).

As a result of this retail agglomeration, a complicated web of inter-store externality is created, assuming that the traffic and sales of each store depends in part on how many customers the other stores attract (Gould *et al.*, 2005).

Positive inter-store externalities, sometimes referred as demand externalities, are the positive effects generated from one or more tenant(s) to other tenant(s) without consent between the generator and receiver. These demand externalities have been recognized as significant agglomeration economies that generate increased returns in shopping centers (Fujita and Thisse, 2002). Conversely, negative externalities can generate lower rates of return (Eppli and Benjamin, 1994).

Thus, the success of each store depends upon the presence and the effort of other stores, and also the effort of the developer to maintain the mall (both as an infrastructure pipe and a business). On the other hand, the success of the center is strongly connected with the extent to which stores can internalize positive externalities and eliminate the sources of negative ones.

Store types differ, as known, in their externality-generating abilities. Therefore, inter-store externalities must be internalized by subsidizing the rent of stores that generate mall traffic to other stores (and charging a rent premium to the beneficiaries) so that space is efficiently allocated.

Several previous researches widely recognized that stores within commercial centers generate sales or business traffic externalities amongst themselves (see, *e.g.*, Gould *et al.*, 2005; and Wheaton, 2000). Many others even argue demand externalities are unidirectional – from anchor to non-anchor stores – (see, *e.g.*, and Gerbich, 1998; Eppli and Shilling, 1993; and Ingene and Ghosh, 1990). However, this leads us to relevant issues: a) how to distinguish the (externalities) generator and receiver one, *i.e.*, who relies upon whom, b) how rents of 'strong tenants'[2] are subsidized based on externalities generation, and c) how efficiently allocate mall space in order to increase center turnover and retailer profits.

In fact, the importance of each store's effort to the overall mall performance is related to the net externalities generated by all others stores. Therefore, charging the same rent and designing the same level of incentives for each store seems to be highly inefficient: stores which generate the most positive externalities by their presence and effort should pay lower rents per square meter and have larger incentives to exert effort (Pashigian *et al*., 1998). Furthermore, stores that confer large external benefits on other stores should also receive more space within the center (Miceli *et al*., 1998).

Understanding the full impact of the inter-store externalities on mall performance is a prerequisite for translating them into appropriate space allocation and rent determination decision rules which, therefore, remains a very complex task. A large body of literature has already proved the power of anchor stores; however, analyze the complex problem of an efficient space allocation in shopping centers in the presence of inter-store externalities has received less attention and call for more research on this issue.

This thesis has two main objectives. First, we intend to shed light on the impact of inter-store externalities created by anchors on sales and rents of non-anchor stores. Second, we aim to demonstrate how malls price the net externality of anchor stores in order to achieve an efficient allocation of space. In doing so, we propose to confirm that anchors generate positive externalities by increasing the sales of non-anchor stores, and in turn, non-anchor stores pay for those benefits through higher rents. Basically, we intend to see how the Sonae Sierra's model is responding to those issues.

We contribute to the existing literature in two distinct ways. First, and besides using a unique data of mall performance and characteristics information, as we state below, we identify a very important and intriguing problem: if anchors do generate sales for other stores, what implications does this have for the rents of the non-anchor stores? Second, using those insights we aim to explain how a developer should allocate space in center among stores whose sales are interrelated through externalities in order to achieve the highest profits and investment returns possible. The answers to these questions are

[2] See Yuo *et al*. (2003)

crucial for mall developers interested in overall mall performance, yet, it is not straightforward.

Throughout this empirical analysis, we exploit a rich dataset of 35 Sonae Sierra's commercial centers, from Portugal and Spain, containing important information, such as: sales, traffic people, age of mall, size, number of stores, fixed and overage rent, on a yearly basis, of about 4,000 stores. Unlike many authors studying this problem, we have the privilege of multiple-period observations: 2005 to 2007. Hence, "cleaner" estimates of within-mall externalities between stores may actually be achieved. Besides, such a complete and large sample enable us to walk straight to the answers of the issues mentioned above, in a more accurate manner, *i.e.*, studying annual data and verifying the stability in time of the conclusions found.

The thesis is structured as follows. We start with a summary of the relevant literature followed by a brief description of Portuguese market leader, Sonae Sierra, whose data is used in this thesis. Section 4 conceptualizes the impact of externalities on stores sales and rents, and on overall mall performance. Section 5 presents the methodology used to carry out our research. Section 6 introduces the empirical analysis. It describes our unique dataset, variables and estimation results based on STATA® and SPSS® software tools. Section 7, finally, provides conclusions and indicates areas for future research.

2 LITERATURE REVIEW

In this section, we provide an overview of published research results in three domains of interest to this thesis. The first two research streams relate to *relevant determinants of commercial center success* and to *retail rent determination*. Given our interest in profit-maximizing developer implications, an overview of *manage inter-store externalities* literature is provided in the third part of this review.

2.1 Relevant Determinants of Commercial Center Success

Taking location theories as the conceptual background (Weber, 1929), sales potential in commercial centers are looked upon through the concepts of *agglomeration economies* and *externalities* derived from the presence of anchor tenants (Eppli and Benjamin, 1994; Fisher and Yezer, 1993; Ingene and Ghosh, 1990; Ghosh, 1986; West *et al*., 1985; Mulligan, 1983; and Eaton and Lipsey, 1979), as well as from *tenant mix* and *product diversity* (Mejia and Benjamin, 2002; and Pashigian and Gould, 1998)[3]. Taking this into account, an overview of these four concepts seems to be mandatory to a broad understanding of their impact on the performance of a commercial center. However, since our main interest lies on the role of inter-store externalities in determining the centers' optimal space allocation, a deeper attention is given to this issue.

2.1.1 Agglomeration Economies

There exists a considerable body of literature that studied the economic reasons behind the co-location of firms – as seen in commercial centers and other centralized clusters.

In retail location theory, Nelson (1958: 58) was the first to illustrate that agglomeration of retail activities is based on the theory of cumulative attraction which states that "a given number of stores dealing in the same time merchandise will do more business if they are located adjacent or in proximity to each other than if they are widely scattered". Kalnins and Chung (2004) also emphasized that agglomeration among retail can

[3] Meijia and Benjamin (2002) also state non-spatial factors (*e.g.*, retail brand and image) as relevant determinants of shopping center sales. However, since our main interest lies on externalities, those are unnecessary to highlight in this thesis.

heighten demand by attracting more customers than the sum of those that the agglomerating firms would attract individually.

As a result of co-location of stores, a retailer can reduces consumer search costs and thus attracts more consumers. Consumers economize on the amount of time spent shopping, by making multipurpose shopping trips, combining purchases for different product categories and reducing the number of trips at a particular time period, or by purchasing a large amount of goods, for example, groceries, while making a singlepurpose shopping trip (reducing travel costs by combining trips over time) (Popkowski *et al*., 2004).

Retail agglomeration can include both homogenous and heterogeneous clustering of retailers. Clusters of heterogeneous stores, based on central place theory, provide consumers with an increased opportunity for multipurpose shopping and a reduction in total travel costs (Ghosh, 1986; Huff, 1964; Converse, 1949; and Reilly, 1931). The clustering of homogeneous retailers, based on the concept of minimum differentiation, allows for comparison-shopping at agglomerated sites (Eaton and Lipsey, 1979).

Results from empirical studies have reported that between 30%-50% of all shopping trips are multipurpose (Popkowski and Timmermans, 2001; O'Kelly, 1983). Retailers have responded to this assumption by providing a wide assortment of products allowing consumers to combine purchases in multiple product categories.

2.1.2 Inter-Store Externalities

While retail agglomeration economizes on consumer search and uncertainty costs, a complicated web of externality is created, assuming the profit and traffic of each store depend in part on how many customers the other stores attract (Gould *et al*., 2005).

An externality arises when one part directly conveys benefit or cost to others (Lu, 2008). Thus, positive inter-store externalities, also referred as demand externalities, are the positive effects generated from one or more tenant(s) to other tenant(s) without consent between the generator and receiver. These demand externalities have been recognized as significant agglomeration economies that generate increased returns in shopping centers (Fujita and Thisse, 2002). Conversely, negative externalities can generate lower rates of return (Eppli and Benjamin, 1994).

These two types of situations - the generation of positive and negative externalities - have interesting implications with respect to the ensuing discussion concerning malls. However, while positive externalities generation are strongly associated to anchor stores, so far the negative ones are not so well researched. According to several authors, this is part of a general lack of research into the complex matter of inter-store externalities.

In fact, agglomeration of stores inevitably creates free-rider problems because the success of a store depends, in part, on the presence of other stores within the mall, especially on the presence of anchor stores. A common claim is that consumers are attracted to malls because of the presence of well-known stores - department stores with recognized names. By generating mall traffic, anchors create external economies by indirectly increasing sales and/or reducing promotion and other costs of a host of smaller stores. Therefore, lesser-known stores can free ride off of the reputations of better-known stores (Pashigian and Gould, 1998).

Those ‘better-known stores’, so-called anchor stores, have been subject to numerous definitions, all of them including ‘size’, ‘attraction’, ‘recognition’, ‘chain of stores’, ‘traffic generator’, and ‘stores benefit from its presence’ as main elements. One of its definitions was developed by Konishi and Sandfort (2002: 2), who state that an anchor store “is a store that increases, through its name's reputation, the traffic of shoppers at or near its location”. The problem is that this kind of definition is ‘endogenous’ in that the characterization of an anchor store already hinges on its ability to generate traffic/sales. Hence, based on objective characteristics, Sonae Sierra defines anchor store as a unit integrated in a shopping center mix of tenants with the purpose of significantly increasing the scheme attractiveness to the customer. It comprises all or most of the following features:

- Large (commonly above $600m^2$ Gross Livable Area (GLA));
- Multiple (national or international chain – a minimum of 3 stores);
- Has a strong brand (high awareness and positive response levels);
- Adds significant traffic (specifically generates footfall);
- Wide attractiveness: this is taken to mean it would trade successfully as a stand-alone unit;
- As an ex-post test, an anchor tenant usually enjoys a privileged position in the rent and service charges.

Basically, the anchor tenant sets the tone and image of the shopping center (Ibrahim and Galven, 2007). In general, consumers are likely to visit the shopping center because of its anchor tenants; this in turn helps to generate sales and profits for the other ‘lesser-known stores’.

The importance of anchor tenants has been stressed earlier, yet it would be a mistake to think that a commercial center could prosper without the independent small tenants. Even though some anchor tenants do provide a wide selection of goods and services at a discounted price, they are not sensitive in providing for the ever-changing needs of the consumers. On the other hand, small retailers may carry a limited range of products and services, but they are more flexible and yet specific in catering to consumers' needs. Moreover, small retailers yield higher rentals per square meter as compared to anchor tenants in the same shopping center (Ibrahim and Galven, 2007).

If positive externality arises when one part directly conveys benefit to others, analogously, a negative externality arises when one party directly imposes a cost to others, *e.g.*, business taken away by a new store from the existing stores (Lu, 2008). A notable research on the issue is provided by Yeates *et al.* (2001). Their results point to the following conclusions: there is no doubt that the closure of the department store had a negative impact on other stores in the malls involved in the analysis. However, the negative impact did not result, in the aggregate, in current dollar losses: it was marked only in those stores closest to the shopping center entrances and not similarly patent in all merchandise categories. It would appear that if the absence of an anchor can dampen aggregate sales in adjacent stores by about 12%, then a vibrant anchor may stimulate aggregate sales in adjacent stores by a similar percentage.

This illustrates why developers must take account of externalities in choosing the types, sizes and location of stores in the center in order to optimize externalities and make the center as profitable as possible.

2.1.3 Tenant Mix

Emerging from the literature on the design and evaluation of shopping malls, the tenant mix or the space allocation and location of the retail stores is an essential characteristic of the shopping mall: “a full line-up of strong and well placed traders is important to the retail tenant, whose performance is dependent on the level and type of footfall attracted.

The success of individual tenants and the success of a center as a whole are interdependent and enhanced by the cumulative synergy generated by the mix of stores." (Kirkup and Rafiq, 1994: 29). Being certainly one of the most crucial elements on the generation of inter-store externalities and in establishing the image of a commercial center, its impact on the performance of a commercial center cannot be neglected.

As stated by Kaylin (1973) cited in Downi *et al*. (2002: 5), tenant mix refers to the "combination of business establishments occupying space in a shopping center to form an assemblage that produces optimum sales, rents, service to the community and financiability of the shopping center venture". Hence, optimizing tenant mix involves choosing the right tenant, with the right size, selling the right product at the right spot (Des Rosiers *et al.*, 2009). Therefore, under the mixture of tenants, strong brand name and other popular stores spillover their sales efforts to other tenants (Miceli and Sirman, 1995), establishing the positive image of the center.

A good tenant mix includes a variety of compatible (or complementary) retail/service providers, and an efficient space allocation (both size and number) and proper tenant placement that encourages the interchange of customers and retail activities. In a wider perspective, it should also include sufficient public facilities and services, both in terms of the quality and quantity demanded. The essentials that enhance the quality of the center's shopping environment, to satisfy shoppers' needs, such as goods and services, convenience, excitement, and amenities, are all part of the elements of an ideal tenant mix - otherwise, it can result in a resounding failure.

However, tenant mix is not a static condition: the market changes over time, as do the customer preferences and fashion trends. Therefore, even the "ideal" condition achieved in one season or period might not be suitable for the next one. Consequently, center developers have to adjust their tenant mix constantly to keep up with the market trends (Yuo *et al.*, 2004).

2.1.4 Product Diversity

As known, from agglomeration theory, variety of retail/service is an important factor in increasing productivity in the traded-good sector (Fujita and Thisse, 2002; and Fujita, 1989). Fischer and Harrington (1996: 281) thus suggested "greater product heterogeneity increases consumer search, which raises the amount of shopping at a cluster".

The larger the shopping center, the more variety it needs. The greater the variety it has, the higher the productivity it can achieve. Consequently, clustering of retailers can generate variety and increase attraction. However, variety is not merely the diversity of product combinations but should include certain principles to maximize the favorable effects that generate increasing returns. In a shopping center, product variety comes from the combination of retail/service tenants - the tenant mix strategies that are adopted by the manager (Yuo *et al.*, 2004).

2.2 Retail Rent Determination

The empirical research on shopping center rents has revealed several findings (see, *e.g.* Eppli and Benjamin, 1994; Sirmans and Guidry, 1993). First, smaller retailers are willing to pay a rental premium to locate in planned shopping centers having high-order retailer customer drawing power. Second, there is a trade-off between base rents and overages. And, third, retail rents are determined by a set of factors that include: a) customer drawing power, which includes a vector of physical building characteristics and a vector of anchor tenant type (*e.g.*, national, regional, or local); b) design characteristics of the center, such as strip center layouts versus enclosed mall design; c) market condition variables such as occupancy rates, population or households, and income; and d) other specific location attributes.

The current literature suggests that rental rates are largely determined by the shopping center's physical characteristics and location, along with the opportunity of smaller tenants to locate proximate to a major anchor tenant (Gatzlaff *et al.*, 1994).

In Eppli and Shilling's (1993) model, they observed that anchor tenants have far lower rentals per square meter than independent small retailers. This is due to anchor tenants being able to enjoy rents that are heavily discounted[4]; developers use this strategy to lure the well-established anchor tenants into their shopping centers. On the other hand, the small retailers do not have much bargaining power and the developer sees no incentive to lower their rentals; hence, small retailers usually have to pay a higher rent

[4] Major tenants are able to negotiate lower rents with developers (Anderson, 1985), as their departure may cause rental income to drop by as much as 25% (Gatzlaff *et al*., 1994), a fact that greatly enhances their bargaining power.

per square meter than anchor tenants[5]. Basically, stores whose reputation, size or products tend to draw customers will pay less per square meter, while smaller, less known retailers who depend on passing-by traffic will pay more (Wheaton, 2000).

For all stores, the rental payment is determined by three provisions in the contract: (1) the fixed base rent, (2) the threshold level of sales, and (3) the overage sharing percentage (Gould *et al*., 2005). Each month, a store must pay the specified fixed base rent (*i.e.*, the base rent per square meter of GLA). If the store's sales exceed the threshold level, the store must also pay an overage component equal to a percentage (determined by the overage sharing percentage) of sales above the threshold level. That is, some stores theoretically may have to pay a portion of their sales above the threshold, but if their sales do not exceed the threshold in practice, the store just has to pay the base rent.

According to Gould *et al*. (2005) analysis[6], the most striking feature of anchor contracts is that most anchors either do not pay any rent or pay only a trivial amount. This means, most anchors have a zero base rent[7] and do not reach their threshold level of sales, thus paying no rent even though theoretically they could if their sales were high enough. Another striking feature concerns the sharing percentages: non-anchor stores are more likely to have sharing provisions in their contracts, with only 1% of non-anchor stores required to pay base rent only, compared to 76% of anchor stores. Furthermore, few anchors are eligible to pay overage, but similar to non-anchors, many of them do not reach the threshold level. The last striking regularity is that anchors have much lower sharing percentages than non-anchor stores (0.47% for anchors and 6.27% for non-anchor stores).

These findings reveal that the provisions of the lease are flexible enough to determine how much the rent will be based on the performance (sales) of the store, and how much is fixed in advance. Moreover, an intriguing issue is that these contracts are not designed to share risk, as several authors defend (see, *e.g.*, Miceli and Sirmans, 1995; and Brueckner, 1993) but more to align incentives between anchor tenants and

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[5] Due to this discrimination in retail rents, a recent phenomenon has been observed: more landlords do not try to replace anchor tenants alike when they cease operations. Instead, they invest considerable capital into renovations to convert the large vacated space to micro-mini retail space to accommodate many times more tenants marketed within a single concept (Ibrahim and Galven, 2007).

[6] They used a database for over 2,500 stores in over 35 large malls across Unites States in 1994.

[7] In some of these situations, the anchor owns its building and sometimes the land.

developer – lowering non-anchor threshold and increasing non-anchor sharing percentages.

Consistent with Sirmans and Guidry (1993), the rental rates charged to shopping center tenants are assumed to be related to *customer drawing power* (influenced by the size and age of the center, and anchor tenant information) *market condition* (demographic and economic attributes of the primary market area of the center), and *shopping center's physical characteristics and location* (design of the center and specific locational characteristics of the site).

2.3 Manage Inter-Store Externalities

Once emphasized the synergy effects that can be generated by retail agglomeration, how to internalize or manage inter-store externalities is the next main issue.

Previous research has demonstrated that without any incentive or compensation, the 'strong tenants' – the strong, positive, externality generators – will not maintain or enhance their ability to generate positive effects for other tenants (see, *e.g.*, Yuo *et al.*, 2003; and Pashigian and Gould, 1998). These incentives or compensations are considered in three economic theories: a) Pigouvian tax/subsidy, b) Coase Theorem, and c) constraint regulations through government intervention. The *Pigouvian tax/subsidy approach* directly implies a tax/subsidy mechanism between the effect generators and receivers: tenants that generate positive externalities should be subsidized by those who enjoy these benefits. In a more recent published article, Pashigian and Gould (1998: 115) suggest the concepts of 'rent premiums' and 'rent subsidies' should be implied in this process: "mall developers internalize these externalities by offering rent subsidies to anchors and by charging rent premiums to other mall tenants". In line with this statement, a considerable number of studies document that percentage rent payments are smaller for stores that generate the most (positive) externalities (see, *e.g.*, Gatzlaff *et al.*, 1994; and Brueckner, 1993).

In a more general view, *Coase theorem* asserts that by clearly delineated the property rights of the externalities, the efficiency condition (Pareto Optimal) between the effect receivers and generators can be achieved by negotiation. However, high transaction costs usually become an obstacle to internalizing externalities through these two approaches. Under such a circumstance, *rules or regulations* set and implemented by government or a third party (mall developer) become the best and most feasible way to manage externalities.

Taken together, these three basic approaches lead us to a relevant conclusion: a full understanding of in-center externalities and the way that the contribution of positive generators is “rewarded” by a lower rent is important in modeling shopping center rents (Yuo *et al.*, 2003).

Besides, in shopping centers, clearly defined physical and intangible rights and obligations in the leasing contract can eliminate the sources of negative inter-store externalities, so as to prevent conflicts between tenants and the center manager. A well designed and implemented tenant mix strategy can also prevent negative effects among tenants by tenant selection specific retail categories. Furthermore, agglomeration economies can be enhanced by internalizing the externalities through service charges, leasing incentives and other non-monetary obligations among tenants, so as to establish the strongest tenant mix (Yuo *et al.*, 2003).

However, this is more easily said than done. For one, it is hard to distinguish the generator and the receiver ones, *i.e.*, who relies upon whom, and then distribute the optimal amount of incentives to exert effort to each of the three major participants in a mall: the developer, the anchors, and non-anchor stores. As known, the developer depends on each store owner to exert effort not only to maximize their own store’s profit, and consequently their willingness to pay more rent, but also to generate more traffic to other stores as well.

Even though it is observed that the presence of an anchor store will lead to many benefits for the developer, one should note that having an increasing number of anchor stores in a shopping center would not work towards the developer's profit maximizing goals (Ibrahim and Galven, 2007).

As emphasized by West (1992), owners of shopping malls are selecting retail stores and their locations in a profit-maximizing way. Even so, there remains room for improvement: they need to be more aware of the impact of inter-store externalities and ways of manage them which, therefore, contribute to achieve an efficient allocation of a commercial center space.

3 SONAE SIERRA[8]

"We are guided by our belief that the people who visit our centers want to enjoy more than just a satisfying shopping experience"

Portela (CEO), 2006

Sonae Sierra is a part of a larger conglomerate named SONAE, whose roots can be found in the 60s of the last century. More precisely, Sonae was founded in August 1959, initiating its activities in industrial area of wood laminates. These activities were persecuted until the 70s, when Sonae began its activities diversification.

Nowadays, Sonae is structured in six main areas of business, as shown in Fig. 1.

Fig. 1 – Sonae Business Areas[9]

Incorporated in Portugal in 1989, Sonae Sierra is an international shopping center specialist owned by Sonae SGPS (Portugal) with 50%, and Grosvenor (United Kingdom) with 50%. The first two Commercial Centers managed by Sonae Sierra started operating in 1989 in Portimão and Albufeira, Portugal. This was followed in

[8] Based on Sonae Sierra (2010).

[9] http://www.sonae.pt/pt/sonae/areas-de-negocio/

1991 by the opening of Cascais Shopping – the first modern Commercial Center in Portugal.

Nowadays, Sonae Sierra operates in Portugal, Spain, Italy, Germany, Greece, Romania, and Brazil, where it manages 51 Shopping Centers with a total GLA of about 2.0 million m^2, 8,924 tenants and, with more than 436 million visits in 2009. Simultaneously, it provides services to third-parties in Serbia, Cyprus, Morocco, and Colombia. Besides, Sonae Sierra has 3 more projects under construction and 7 new projects in different phases of development in Portugal, Italy, Germany, Greece, Romania and Brazil.

Sonae Sierra defines six clusters of commercial centers located in Portugal:

Table 1. Sonae Sierra – The Six Clusters[10]

Cluster	Definition	Marketing Communication	Commercial Centers
Champion	Large center with great diversity	"Has everything you can imagine"	Colombo NorteShopping
Family	For families; Usually located in the periphery of large urban centers	Target: children and families; fun and playful communication	LoureShopping RioSul Shopping MaiaShopping GaiaShopping
Fashion	Fashion: provides the best mix of clothing and accessories stores	Addressed to trendy and urban public	CascaiShopping AlgarveShopping ArrábidaShopping Madeira Shopping
Regional	Located in an area with weak competition; strong drawing power; great diversity	Explores the emotional and functional side of public showing that it is a local partner who understands the people and region	Estação Viana Parque Atlântico SerraShopping LeiriaShopping 8ª Avenida GuimaraeShopping Tavira Granplaza
Downtown	Located in an area with high traffic: residents, workers and tourists	Increases the level of engagement of usual customers and attracts new ones	Via Catarina Centro Vasco da Gama
Urban	Located in proximity; strong inter-personal relationship with tenants and customers; high quality	Increases the level of engagement and rewards usual customers for their preference	CC Continente de Portimão CoimbraShopping AlbufeiraShopping

[10] Based on Gonçalves, 2010

Sonae Sierra pursuits an "integrated approach" to the business - Shopping Center & Retail Parks - meaning the ownership, development and all the management activities required. The company owns know-how and expertise required to the entire Shopping Center development process: *Planning* → *Investment* → *Building* → *Management*, and runs it under the mission "to create value for our shareholders, while taking into account our social responsibilities towards our other important stakeholders, as well as the environment". (Sonae Sierra, 2010: 5)

To get a deeper idea of Sonae Sierra's dimension, behind its 51 Shopping Centers and the dynamics of evolution, we can take into account the following Table 2 and 3[11]:

Table 2. Sonae Sierra's Growth and Performance Indicators

Performance Indicators	**Growth (as % of previous year)**					
	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Real Estate NAV as at 31 Dec per share	12%	19%	18%	15%	-17%	-13%
GLA (m^2) owned in operating Centers	13%	16%	4%	14%	3%	4%
GLA (m^2) under management	17%	10%	-1%	9%	-1%	5%
Number of tenant contracts under management	13%	16%	1%	11%	3%	5%

Table 3. Sonae Sierra's Performance Indicators

Performance Indicators	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Real Estate NAV as at 31 Dec (€ million)	1,060	1,265	1,490	1,713	1,416	1,228
Real Estate NAV as at 31 Dec per share (€)	32.6	38.9	45.82	52.69	43.55	37.78
GLA owned in operating Centers (000's m^2)	1,362	1,586	1,660	1,900	1,963	2,059
GLA under management (000's m^2)	1,839	2,025	2,001	2,200	2,163	2,284
Number of tenant contracts under management	6,134	7,166	7,293	8,162	8,455	8,924
Consolidated NOI - IAS (€ million)	107.6	125.7	150.3	156.2	179.3	180.3
Consolidated Net Profit - IAS (Euro million)	82.3	148.15	160.3	300.1	-198.2	-159.9

[11] Adapted from Sonae Sierra (2010)

According to Inês Vasconcelos Proença, Marketing Europe B2C Manager at Sonae Sierra, in Gonçalves (2010: 12), “the ability of constant innovation in the last twenty years was what dictated the success of Sonae Sierra”. In fact, thanks to the expertise, innovation and good results, Sonae Sierra earned an international reputation and collected more international prizes than any other company in the sector.

4 CONCEPTUAL FRAMEWORK

Based on the above literature, we develop a framework that characterizes the impact of demand externalities created by anchors on sales and rents of non-anchor stores. Accordingly, it also clarifies their impact on overall mall performance. This framework is depicted in Fig. 2.

The starting point for this framework is a set of relevant determinants of shopping center success. From the literature review, we retain some spatial factors (agglomeration economies, inter-store externalities, tenant mix, product diversity) that may influence mall performance. In one more detailed perspective, we conceptualize the way inter-store externalities may influence store/mall performance.

According to the stylized model developed by Eppli and Shilling (1993), there are two types of tenants: a) anchor; and b) non-anchor tenants. The anchor tenants create a draw card for the center and the non-anchor tenants' benefit from locating near the anchor – such a dynamic interaction should be carefully planned, in view of the complex way in which developer decisions influence store/mall performance.

Fig. 2 suggests that anchor stores may trigger a *mall draw effect*, *i.e.*, attract additional business to the center, either by inciting current customers to spend more at the center, or by attracting new customers. This mall draw effect creates interdependencies between all stores in a mall: each store affects other stores' sales and, therefore, the overall mall performance. To illustrate, customers drawn to a specific mall by an attractive (anchor) store may visit other stores engaged, for instance, in impulse buying.

Another important issue that is also clarified in Fig. 2 is related to retail rents: stores that potentially generate the most positive externalities pay lower rents per square meter and this constitutes an incentive or compensation due to its attraction power. In turn, smaller stores, benefiting from the generation of demand, pay higher rents per square meter. As demonstrated by Gould *et al*. (2005), contracts are designed more to align incentives between anchor tenants and developer. Hence, rentals on retail space are extremely sensitive to the sales volume and externalities generated by the store (Sirmans *et al*., 1993). Finally, the developer must take this into account when choosing the optimal allocation of space to the stores, in order to maximize total center rental and, therefore, mall performance.

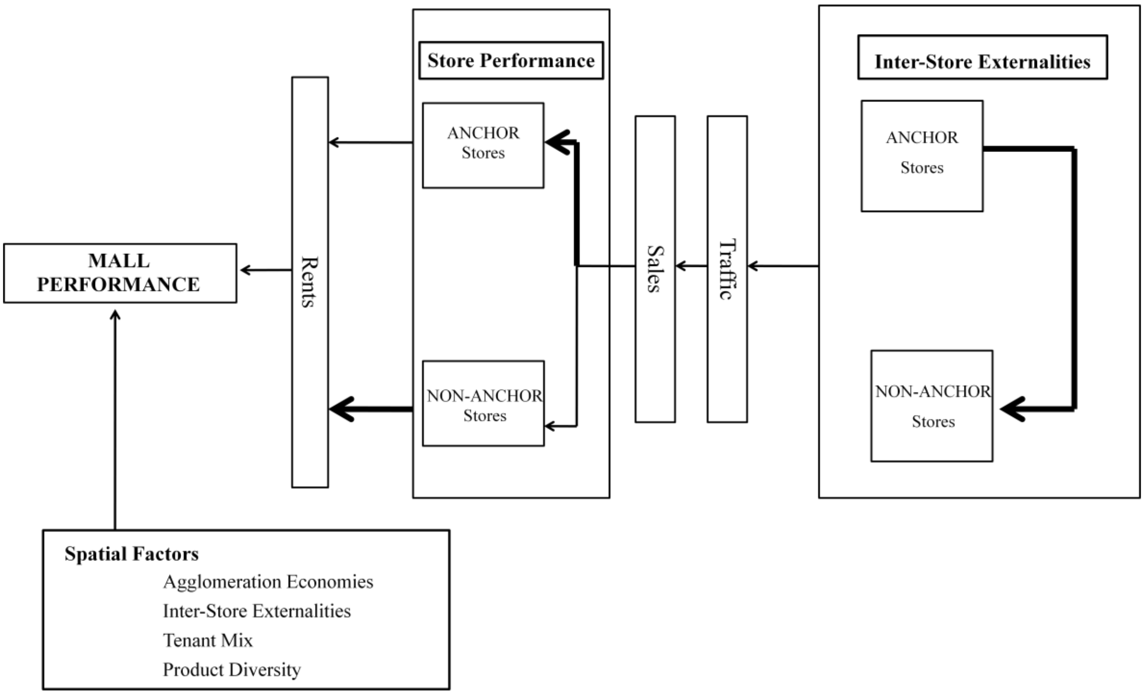

Fig. 2 – Impact of Externalities on the Performance of a Store/Commercial Center

Based on this, we can identify three important research questions: (a) how anchors generate sales for other stores, (b) what implications does this have for the rents of the non-anchor stores, and (c) how efficiently allocate mall space in order to increase center turnover and retailer profits. These issues are taken up next.

5 METHODOLOGY[12]

To fully account for the role that externalities play in producing non-anchors level results and more importantly, how it can be translated into an efficient allocation of a commercial center space, a combination of cross section and time series data is used[13]. Such data, so-called longitudinal or panel, allow us to analyze those issues in a more accurate manner, *i.e.*, identifying unobserved heterogeneity and revealing dynamics – difficult to solve and detect with cross-sectional data.

A standard model with panel data is:

$$Y_{it} = \beta_1 + \sum_{j=2}^{k} \beta_j X_{jit} + \sum_{p=1}^{s} \gamma_p Z_{pi} + u_{it} \tag{1}$$

where: Y is the dependent variable, the X_j are observed explanatory variables, and the Z_p are unobserved explanatory variables. The index i refers to the unit of observation, t refers to the time period, and j and p are used to differentiate between different observed and unobserved explanatory variables. u_{it} is a disturbance term assumed to satisfy the usual regression model conditions.

Being Z_p variables responsible for unobserved heterogeneity and as such constitute a nuisance component of the model, we can confine it to the (quite common) special case where it is reasonable to assume that unobserved heterogeneity is unchanging and accordingly do not need a time subscript. Furthermore, there is no means of obtaining information about unobserved variables and, therefore, it is convenient to rewrite (1) as:

$$Y_{it} = \beta_1 + \sum_{j=2}^{k} \beta_j X_{jit} + a_i + u_{it} \tag{2}$$

where,

$$a_i = \sum_{p=1}^{s} \gamma_p Z_{pi} \tag{3}$$

[12] Based on Wooldridge (2003) and Dougherty (2007)

[13] Basically, we exploit a rich dataset of 35 Sonae Sierra's commercial centers, observed periodically: 2005-2007.

If the X_j controls are so comprehensive that they capture all the relevant characteristics of the commercial center individual, there will be no relevant unobserved characteristics. In that case the a_i term may be dropped and a *pooled OLS regression* may be used, treating all the observations for all of the time periods as a single sample. However, if a_i is correlated or uncorrelated with any of X_j variables, the regression will be subject to unobserved heterogeneity bias or yield inefficient estimates and invalid standard errors. In those cases a *fixed-effects model* or *random-effects model* may be used, respectively.

But how can we assess the appropriateness of the models according to our dataset? Using STATA® software tool we identify the best model, firstly by running Breusch-Pagan Lagrange multiplier test and then the Durbin-Wu-Hausman (DWH) test[14]. The former was developed by Breusch and Pagan in 1980 and helps to choose between the pooled regression and the random effects regression:

H_o: pooled regression model

H_a: random effects model

If the null hypothesis is not rejected, the pooled regression model is favored.

The Durbin-Wu-Hausman (DWH) test is the classical test of whether the fixed or random effects model should be used. The research question is whether there is significant correlation between a_i and the X_j variables:

H_o: a_i and X_j are uncorrelated

H_a: a_i and X_j are correlated

If there is no such correlation, then the random-effects model may be more powerful and parsimonious. If there is such a correlation, the random-effects model would be inconsistently estimated and the fixed-effects model would be the model of choice.

When the fixed-effects approach is appropriate, we can have three models' versions:

[14] The fixed-effect model can also be tested by the (incremental) F test.

– *Within-groups fixed-effects model*: the mean values of the variables in the observations on a given individual are calculated and subtracted from the data for that individual[15].

$$Y_{it} - \bar{Y}_i = \sum_{j=2}^{k} \beta_j (X_{jit} - \bar{X}_{ij}) + u_{it} - \bar{u}_i \qquad (4)$$

– *First differences fixed-effects model*: unobserved effect is eliminated by subtracting the observation for the previous time period from the observation for the current time period, for all time periods[16].

$$\Delta Y_{it} = \sum_{j=2}^{k} \beta_j \Delta X_{jit} + u_{it} - u_{it-1} \qquad (5)$$

– *Least squares dummy variables fixed-effects model*: the unobserved effect is treated as the coefficient of the individual-specific dummy variable, the $a_i A_i$ term[17] represents a fixed effect on the dependent variable Y_i for individual *i*, and it can be estimated using OLS.

$$Y_{it} = \sum_{j=2}^{k} \beta_j X_{jit} + \sum_{j=1}^{k} a_i\, A_i + u_{it} \qquad (6)$$

Considering now that random effects regression is appropriate, the model is:

$$Y_{it} = \beta_1 + \sum_{j=2}^{k} \beta_j X_{jit} + u_{it} \qquad (7)$$

In short, the empirical research is based on statistical techniques for estimating panel data model in order to show that anchors generate positive externalities by increasing the sales of non-anchor stores, and in turn, non-anchor stores pay for those benefits through higher rents. Besides, we aim to give some clues on how to achieve an efficient allocation of commercial center space.

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[15] The unobserved effect disappears but the intercept β_1 and any *X* variable that remains constant for each individual will drop out of the model.

[16] Again, the unobserved effect disappears but the intercept β_1 and any *X* variable that remains constant for each individual will drop out of the model.

[17] A_i is a set of dummy variables, where A_i is equal to 1 in the case of an observation relating to individual *i* and 0 otherwise.

6 EMPIRICAL APPLICATION

To shed more light on the relevance and implication that externalities carry, not only for sales and rents of non-anchor stores, but also for an efficient space allocation, an empirical application is conducted. This application provides factual evidences on: a) the presence and magnitude of cross-store effects; b) the impact of these externalities on sales and rents of non-anchor stores and c) the achievement of an efficient allocation of mall space. This section describes the data, as well as the estimation procedure and results.

6.1 Data

The dataset covers information on 35 commercial centers of a multinational enterprise – Sonae Sierra[18]. All centers considered in our application are located in Portugal and Spain. Yearly data are provided on store and mall characteristics and performance, for 3 consecutive years: 2005-2007. It is important to underline that these 35 commercial centers, from which 24 locate in Portugal and the other 11 in Spain, were selected in order to have coherent, homogeneous and complete information during the above mentioned period. It is crucial to set a specific time in data gathering in order to keep data quality for later analysis, since tenant composition will change over time. However, given the stability of data over these three years, we decided to cluster the information for descriptive analysis and only mention the yearly data to substantiate some conclusions.

For each mall, the data include the center name, size, age, number of stores, number of anchor stores, traffic people, sales, on a yearly basis. Variables for each anchor store include: sales, size (trade area), store name, age, type, fixed base rent (defined as the part of the rent that does not depend on sales), rent (fixed plus variable), store brand recognition (defined as the number of times the same store appears in all centers divided

[18] There are two main reasons for us to analyze the malls belonging to this Group. First, Sonae Sierra is Portuguese leader in the development of shopping centers, and has rapidly and somehow surprisingly seen its business expand to six other international markets: Spain, Brazil, Germany, Italy, Greece and Romania. The company's upswing in value and its transformation into a highly profitable business have take place just in a few years. On the other hand, there is no reference to the company's business in previous studies. We believe that this fact makes the research even more interesting, especially since one cannot talk about the mall phenomenon in Portugal without taking into account Sonae Sierra's strategies and models.

by the total number of different anchor stores), lease start date, and fraction of mall space (defined as the size of anchor divided by the total size of the center). Variables for each non-anchor store include sales and rents.

Based on information from about 4,000 stores, this thesis uses and presents results referred to one of the most comprehensive datasets of commercial centers available for systematic analysis.

6.2 Estimation Analysis

The empirical analysis is divided into four steps, in accordance to the above theoretical issues: a) descriptive analysis of the dataset, b) estimate a regression model to explain the sales of non-anchor stores, b) estimate a regression model to explain the rents of non-anchor stores, and based on those insights, c) demonstrate how malls may achieve an efficient space allocation. Therefore, we begin with a clear and sound definition of 'anchor store', which is crucial to a broad understanding of the conclusions that we present next. Based on the objective characteristics, Sonae Sierra defines 'anchor store' as a unit integrated in a shopping center mix of tenants with the purpose of significantly increasing the scheme attractiveness to the customer. It comprises all or most of the following features:

- Large (commonly above 600m^2 Gross Livable Area (GLA));
- Multiple (national or international chain – a minimum of 3 stores);
- Has a strong brand (high awareness and positive response levels);
- Adds significant traffic (specifically generates footfall);
- Wide attractiveness: this is taken to mean it would trade successfully as a stand-alone unit;
- As an ex-post test, an anchor tenant usually enjoys a privileged position in the rent and service charges.

For each mall, anchor stores are divided into six types: 'Large Store', 'Unit Store', 'Restaurant', 'Cinema', 'Leisure', and 'Hypermarket'. To keep the terminology manageable, we refer to them as 'Type 1', 'Type 2', 'Type 3', 'Type 4', 'Type 5', 'Type 6', respectively, in the text that follows.

Distinguishing different types of anchor stores allow us to exploit the heterogeneity across anchors. Besides, it contributes to achieve refined conclusions related to the efficient allocation of a commercial center space, *i.e.*, beyond simply showing that all anchors together are compensated for the externalities generated, we identify which ones are (more) compensated and are (stronger) externalities generators. Therefore, this analysis sheds light on the connection between the externality-generating abilities of different types of anchors and the rents paid to the developer for anchor and non-anchor stores within the mall.

6.2.1 Descriptive Analysis of the Dataset

All the 35 commercial centers have, at least, one anchor store with the exception of three small centers in Portugal and one in Spain. Observing the data below (Table 4), it is clear that anchor stores comprise the minority of stores within commercial centers. However, their importance is measured by the total *space* provided, the volume of *sales* achieved, and the amount of *rent* paid.

Table 4. Anchor and Non-Anchor Stores

Stores	**Frequency**	**Percent**
Anchor	170	4.3%
Non-Anchor	3,752	95.7%
Total	**3,922**	**100%**

Observing Fig. 3 and Appendix 1, we can conclude that the premise: ‘stores which confer large external benefits on other stores should receive more space within the center’ (Miceli *et al.*, 1998) is actually implemented by Sonae Sierra – representing only 4.3% of the total number of stores, anchors occupy about 42% of the overall GLA analyzed.

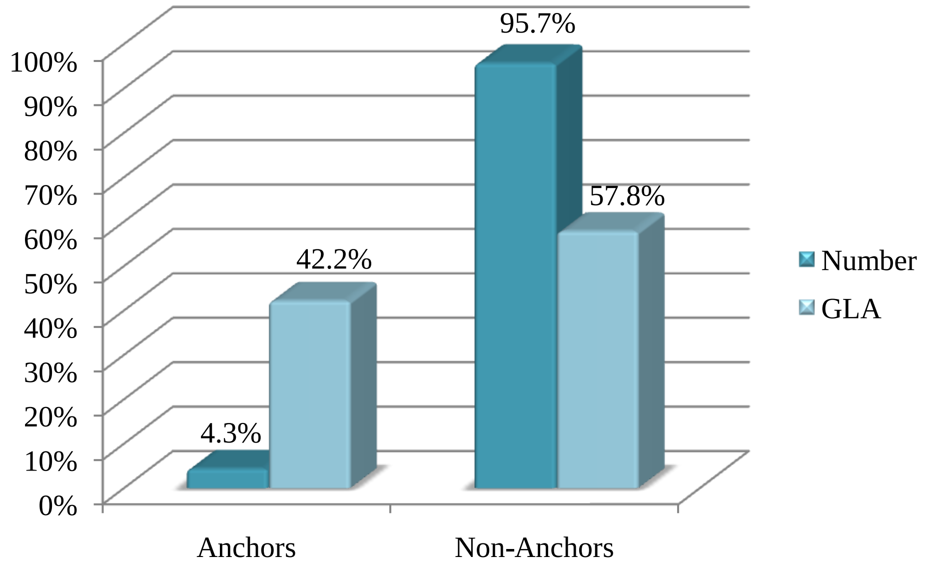

Fig. 3 – Number and Space of Anchor and Non-Anchor Stores

Fig. 4 and Appendix 2 show that, on average, anchor stores represent 93% from the total sales of the centers, and non-anchor stores only account the remaining 7%. These discrepant level results lead us to conclude that anchors seem to draw customers while ‘lesser-known’ stores benefit, for instance, from impulse buying of passing-by traffic since only a small number of customers are swayed to shop at the center by the presence of such stores. Furthermore, we can assume, in line with Wheaton (2000), that not only reputation but also the size of the store may affect its own performance. Such fact may explain why mall developers typically provide more space to anchor stores and, simultaneously, count on them to generate traffic and high volume of sales.

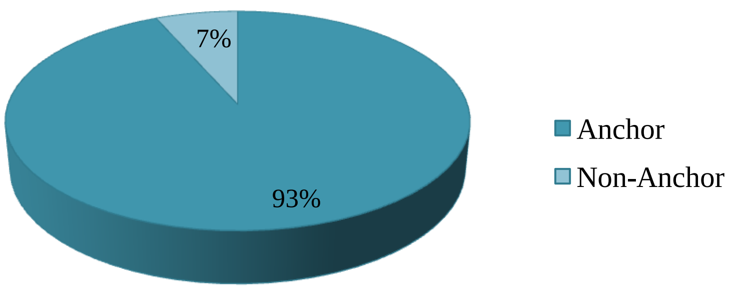

Fig. 4 – Mean Sales of Anchor and Non-Anchor Stores

On a yearly basis, we found that anchors are gradually raising their weight in enclosed commercial centers by increasing their proportion of total sales of the centers, as seen in Table 5.

Table 5. Yearly Sales of Anchor and Non-Anchor Stores

Year	Anchors	Non-Anchors
2005	92.9%	7.1%
2006	93.2%	6.8%
2007	94.1%	5.9%

Fig. 5 and Appendix 3 depict the percentage of base and overage rent that is actually paid for anchor stores to mall developer. Accordingly, 91.4% relates to fixed base rent – defined as the part of the rent that does not depend on sales – and 8.6% to overage rent – defined as the part of the rent that depends on sales. Clearly, contracts benefit anchor stores with low rent based on their performance (sales), by increasing threshold and/or lowering sharing percentages[19].

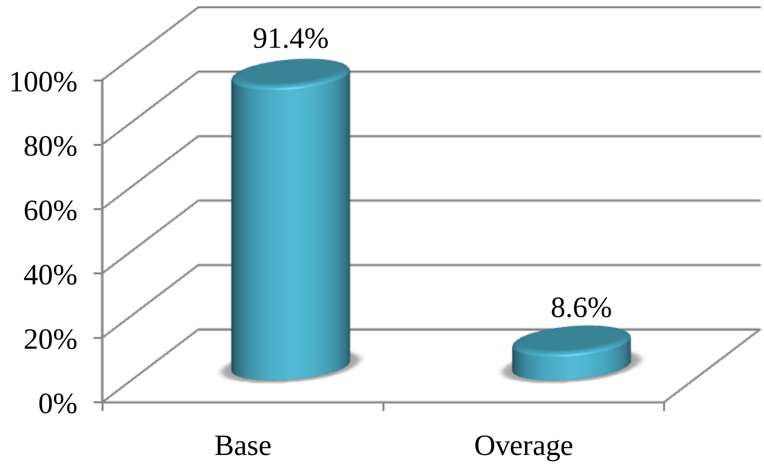

Fig. 5 – Base and Overage Rent of Anchor Stores

[19] The overage rent consists of two factors: a *threshold sales level* and a *sharing percentage*. When sales are below the threshold level, stores are required to pay only the fixed base rent. Overage rent comes into play when store sales exceed the sales threshold. In this case, the store pays the fixed base rent plus a fraction (the sharing percentage) of the store's sales in excess of the threshold level (Gould *et al*., 2005).

In fact, the more the contract is based on fixed rent, as seems to be the case, the greater the store owners' incentives are[20]. In other words, anchor stores pay a fixed base rent and are encouraged to exert effort to maximize their own store's profit and to generate more traffic to other stores by paying a small portion of their sales above one high threshold level – overage rent. So, the more they sell the more they earn as their 'pay for performance' is reduced.

Analyzing Table 6, allows us to verify that 14.1% of the total anchors do not pay any overage rent either. Besides, 11.2% do not pay any fixed base rent and, surprisingly, 3 anchors actually pay zero rent.

Table 6. Anchor Stores' Rent

	Number of AS do not pay	Percent
Base	19	11.2%
Overage	24	14.1%
Base + Overage	3	1.8%

When analyzing the yearly base and overage rent of anchor stores, in Table 7 and 8 (Appendix 4, 5, and 6) we come to the conclusion that beyond the stability is the evidence of a smooth increase of the base rent and, consequently, a smooth decrease of the overage rent, in percentage terms[21]. This may be connected with information extracted from Table 5 as anchor stores are gaining more importance within commercial centers.

Table 7. Yearly Base Rent of Anchor Stores

Base Rent	Value (€)	Percent
2005	35,131,891.05	90.3%
2006	44,835,946,7	91.5%
2007	47,449,845.87	92.0%
Total	**127,417,683.6**	**91.4%**

[20] Conversely, incentives to the developer increase when rents are more contingent on sales performance.

[21] 2005 to 2006 there was an increase in the amount of overage rent paid, despite the decrease in percentage terms.

Table 8. Yearly Overage Rent of Anchor Stores

Overage Rent	Value (€)	Percent
2005	3,762,815.25	9.7%
2006	4,157,436,58	8.5%
2007	4,110,285.86	8.0%
Total	**12,030,537.69**	**8.6%**

In line with current literature (see, *e.g.*, Ibrahim and Galven, 2007; and Pashigian *et al.*, 1998), our dataset reveals that anchor stores pay lower rents per square meters comparing to non-anchor stores. According to Fig. 6, anchors pay only around 18% of the total rent collected by the developer, on average. The sheer size of the subsidy may be explained by the vast externalities created by these types of stores.

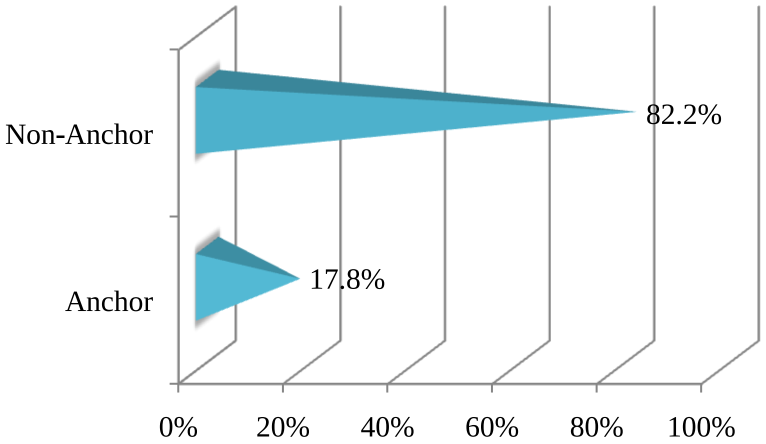

Fig. 6 – Mean Rent of Anchor and Non-Anchor Stores

In addition, non-anchor stores do not have much bargaining power, due to their level results and the degree of benefits acquired from locating near the 'well-known' stores within commercial center. For that reason, the developer sees no incentive to lower their rentals.

Considering results together, we confidently say that anchor stores, as a whole, play an important role regarding the performance of a commercial center. However, seizing the opportunity of having information grouped into six types of anchors, defined above, we are now going to study the contribution of each type. Thus, we strongly believe that it reveals important information that leads us to refine conclusions regarding to our main objective: the efficient allocation of a commercial center space.

As shown in Fig. 7 and Appendix 7, Type 1 anchors account for about 80% of the total number of the overall sample, followed by Type 6 and Type 4 anchors, with 8.8% and 8.2%, respectively. These results are justified by the greater number of different brands' stores considered in those types. (Appendix 8)

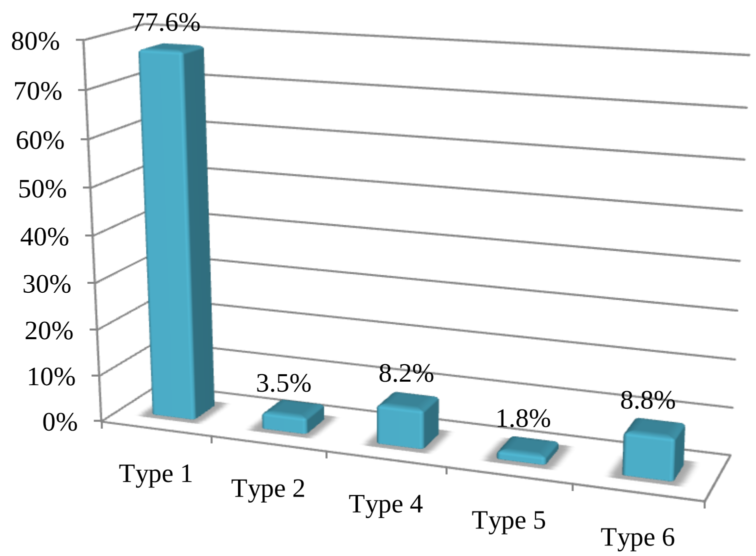

Fig. 7 – Types of Anchor Stores

In order to take out relevant information about each type of anchor store we built Table 9. This table shows a statistical resume for all anchors and for each type of anchor defined above[22]. The Type 2 anchors are noticeably different from the other anchors. To illustrate, the Type 2 anchors have smaller size, later entry into the mall, and a fewer number in malls but they are among the ones that present higher volume of sales per square meter.

In contrast to the Type 1 and Type 2 anchors, the Type 5 and Type 6 anchors tend to be bigger in size and pay low rents. One compelling reason may be that most of the stores defined as Type 5 and Type 6 anchors belong to the mall developer. Thus, it may justify the providing of more space and, simultaneously, the charging of less rent.

Furthermore, the Type 6 anchor is more likely to have been in the mall when the mall was established, as indicated by the lower mean age of the mall when the anchor first arrived in it. These patterns suggest that developers rely more on Type 6 (and 4) anchors

[22] Unfortunately, we do not have discriminated information about Type 3 anchors.

to establish the mall and generate externalities for the other stores. The empirical application will examine these evidences.

Table 9. Mean Values for Anchors

	All Anchors	**Type 1**	**Type 2**	**Type 4**	**Type 5**	**Type 6**
Gross livable area (m^2)	2,999.047	1,768.109	471.000	3,001.951	5,764.423	14,286.733
Number of anchors in mall	4.9	3.8	0.2	0.4	0.1	0.4
Lease start date (year)	2002	2002	2003	2001	2001	2000
Age of mall when anchor first arrived (years)	3.96	3.74	12.17	3.29	3.67	3.27
Sales psm (€)	11,636.78	13,744.47	10,566.98	4,529.13	1,831.63	2,111.80
Rent psm (€)	463.85	544.55	235.96	318.41	118.32	49.69
Sample size	170	132	6	14	3	15

In order to evaluate statistically differences among population group means, the analysis of variance test (ANOVA) was performed. ANOVA provides a statistical test of whether the means of several groups are all equal against the alternative hypothesis that at least two of them differ. However, before running the ANOVA test, the Shapiro-Wilk (S-W) normality test and the Levene’s homogeneity of variance test were applied using SPSS® software tool. The results are summarized in the following tables:

Table 10. Test of Normality

	Type	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Gross Livable Area	1	,101	132	,002	,882	132	,000
	2	,248	6	,200*	,855	6	,174
	4	,181	14	,200*	,879	14	,057
	5	,373	3	.	,779	3	,066
	6	,144	15	,200*	,973	15	,898
Lease Start Date	1	,128	132	,000	,954	132	,000
	2	,319	6	,057	,718	6	,009
	4	,182	14	,200*	,956	14	,655
	5	,175	3	.	1,000	3	1,000
	6	,251	15	,012	,916	15	,165
Age_Mall When Anchor Arrived	1	,245	132	,000	,860	132	,000
	2	,310	6	,074	,805	6	,065
	4	,393	14	,000	,704	14	,000
	5	,204	3	.	,993	3	,843
	6	,167	15	,200*	,936	15	,332
Sales psm	1	,194	132	,000	,678	132	,000
	2	,143	6	,200*	,964	6	,851
	4	,441	14	,000	,511	14	,000
	5	,191	3	.	,997	3	,898
	6	,506	15	,000	,422	15	,000
Rent psm	1	,138	132	,000	,892	132	,000
	2	,474	6	,000	,569	6	,000
	4	,166	14	,200*	,944	14	,471
	5	,321	3	.	,882	3	,330
	6	,514	15	,000	,419	15	,000

a. Lilliefors Significance Correction
*. This is a lower bound of the true significance.

Table 11. Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Gross Livable Area	64,301	4	165	,000
Lease Start Date	2,463	4	165	,047
Age_Mall When Anchor Arrived	1,652	4	165	,164
Sales psm	2,125	4	165	,080
Rent psm	2,869	4	165	,025

Due to the dimension of the sample of Type 1 (always higher than 30 observations), even if the normality assumption is violated, the ANOVA test results are still valid asymptotically. Consequently, we analyze the remaining four types within groups and we verify that each group rejects the normality test in, at least, one type pointing to a violation of the normality (Table 10). Observing Table 11, we confirm that homogeneity of variances test is not rejected for 'Age_Mall When Anchor Arrived' and 'Sales psm' (Sig. > 0.05). However, as the above-mentioned tests point to a violation of at least one ANOVA assumption (normality and/or homogeneity of variances) we carried out the Kruskal-Wallis non parametric test. The results can be summarized as follows:

Table 12. Kruskal-Wallis Test

Test Statistics[a,b]

	Gross Livable Area	Lease Start Date	Age_Mall When Anchor Arrived	Sales psm	Rent psm
Chi-square	56,021	9,604	9,538	38,586	44,246
df	4	4	4	4	4
Asymp. Sig.	,000	,048	,049	,000	,000

a. Kruskal Wallis Test

b. Grouping Variable: Type

The Kruskal-Wallis statistic allows us to test whether the distribution of several groups is equal across 'Gross Livable Area', 'Lease Start Date', 'Age_Mall When Anchor Arrived', 'Sales psm', and 'Rent psm' vs alternative: at least two of them differ. The Chi-Square test and the resulting significance value (Sig. < 0.05) leads us to reject the null hypothesis, which means that equality distribution regarding the five groups is rejected (Table 12).

6.2.2 Explaining the Sales of Non-Anchor Stores

We proceed with our analysis of externalities in Table 14 by presenting the effect of anchors on non-anchor stores sales. In doing so, we decided to study the relationship between the total sales of non-anchor stores and a number of explanatory variables related to anchors and mall characteristics and performance. The variables and the measures that were used are summarized in Table 13[23]:

Table 13. Dependent (D) and Explanatory (E) Variables (Sales)

Variables	**Description**
Total_Sa~NAS	Total Sales of Non-Anchor Stores, in € (D: explaining the sales of non-anchor stores)
Type1	Number of Large Anchor Stores (E)
Type2	Number of Unit Anchor Stores (E)
Type3	Number of Restaurants Anchor Stores (E)
Type4	Number of Cinema Anchor Stores (E)
Type5	Number of Leisure Anchor Stores (E)
Total_Sa~AS	Total Sales of Anchor Stores, in € (E)
Size_Mall	Store Size, measured by the stores total sales surface, in m^2 (E)
GLA_Anch	Gross Livable Area of Anchor Stores, which is the size of trade area, in m^2 (E)
FractionSp~h	Size of anchor divided by the total size of the center, in % (E)
Traffic_Pe~e	Number of people who visited the center (E)
SBR	Store Brand Recognition, measured by the number of times the same store appears in all centers divided by the total number of different anchor stores, in % (E)

Basically, as our main purpose is to check how the anchor stores impact on the sales of non-anchor stores, we included several control variables on the regression model to see if these variables offset the impact of the anchor stores.

[23] Unfortunately, we do not have information about Type 6 anchors.

As data in our sample can be considered a balanced panel with 35 cross-sectional units (the number of commercial centers) and 3 years of observations, we check first which one of these methodologies: pooled or panel data (random or fixed effects) regression is statistically more appropriate to describe the relationship between the dependent and the explanatory variables included in the regression model. To determine the appropriate methodology, we perform two statistical tests, the Breusch-Pagan Lagrange Multiplier test and the Hausman test.

The Breusch-Pagan Lagrange Multiplier test is used to test the pooled regression against the random-effects regression. If the null hypothesis is rejected, the random effects regression is more appropriate than the pooled regression (Baltagi, 2001). The Hausman test is used to test the random-effects regression against the fixed-effects regression. If the null hypothesis is rejected, the fixed-effects regression is more appropriate than the random-effects regression (Baltagi, 2001).

Thus, based on Breusch-Pagan test result, the pooled regression hypothesis was rejected [$\chi_1^2 = 29.28$; p<0.001] in favour of the random-effects regression. (Appendix 9) We then use the Hausman (1978) test to choose between the random-effects regression and the fixed-effects regression. The random-effects hypothesis was rejected [$\chi_4^2 = 30.39$; p<0.001] in favour of the random-effects regression. (Appendix 10) Thus, based on the results of these tests, we run fixed-effects regressions[24]. The obtained results are presented in Table 14.

The variables Type1, Type2, Size_Mall, and SBR were dropped from the model because they do not vary within the commercial centers for the three considered years. This is a weakness of the fixed-effects regression model with negative consequences for the thesis because, as we presented before, Type1 stores are the most representative in the sample being used. Due to this, and despite the Breusch-Pagan and Hausman tests results, we also estimate the random-effects regression model. For now we comment the fixed-effects results.

As one can see, the model is statistically significant (as the probability associated with the F test is 0.000) and the overall R^2 is equal to 0.3426, a value that is also statistically significant due to the F test result.

[24] To estimate the corresponding fixed-effects model, we apply the *xtreg, fe* STATA's cross-sectional time-series regression command.

Table 14. Explaining the Sales of Non-Anchor Stores (fixed-effects regression)

Fixed-effects (whithin) regression		Number of obs =	105
Group variable (i): CC		Number of groups =	35
R-sq:		Obs per group: min =	3
within = 0.5810		avg =	3.0
between = 0.3403		max =	3
overall = 0.3426			
		F (7,63) =	12.48
corr(u_i. xb) = 0.1945		Prob > F =	0.0000

Total_Sa~NAS	Coef.	Std. Err.	t	P > | t |	[95% Conf.	Interval]
Type1	(dropped)					
Type2	(dropped)					
Type3	3306.784	9868.918	0.34	0.739	-16414.68	23028.24
Type4	5553.196	2110.531	2.63	0.011	1335.636	9770.756
Type5	6663.393	6897.287	0.97	0.338	-7119.736	20446.52
Total_Sa~_AS	-.6760964	.0809224	-8.35	0.000	-.837807	-.5143858
Size_Mall	(dropped)					
GLA_Anch	2.080412	1.609045	1.29	0.201	-1.135	5.295832
FractionSp~h	-101829.9	63087.68	-1.61	0.112	-227900.6	24240.76
Traffic_Pe~e	.0002499	.0005816	0.43	0.669	-.0009124	.0014122
SBR	(dropped)					
_cons	62320.64	12831.79	4.86	0.000	36678.360	87962.93
sigma_u	46882.116					
sigma_e	5709.0504					
rho	.98538764	(fraction of variance due to u_i)				

F test that all u_i = 0:	F (34. 63) =	14.64	Prob > F = 0.0000

Based on *t*-test results, we can conclude that only two estimated coefficients are statistically significant: the ones associated with the variables “Type4” and “Total Sales of Anchor Stores”. The first has a positive sign, meaning that on average an additional Type 4 anchor store in one commercial center induces an increase (*ceteris paribus*) of €5553.196 on the sales of the non-anchor stores. This result shows that the mall draw effect created by Type 4 has a great impact on sales of non-anchor stores. Conversely, looking at the estimated coefficient of “Total Sales of Anchor Stores” we notice that on average, each additional unit sales in anchor stores induces (*ceteris paribus*) a decrease of €0.6760964 on sales of non-anchor stores. This is, clearly, an unexpected result, since there seems to be a substitution effect between anchor and non-anchor stores.

As the “wrong” sign for the estimated coefficient of the anchor stores sales, can be due to the multicollinearity problems, we estimate the model considering the sales as the unique explanatory variable and the estimated coefficient remains negative. The same result is achieved even when the random effects regression is considered. Thus, the results point to a substitution effect between the sales of the two kinds of stores.

The evidence in Table 14 that anchors generate sales for non-anchor stores is then soundly rejected with the exception of Type 4 anchors. Such results lead us to conclude that Sonae Sierra’s model is just in part following the previous researches results regarding the impact of anchor stores in the total sales of non-anchor stores (see, *e.g.*, Gould *et al.*, 2005).

Due to the exclusion of explanatory variables with no variation in the three considered years, we also estimate the random effects regression (Table 15). In this case, the number of Type3 anchors has also a positive impact on non-anchor stores sales, the estimated coefficient for the anchor stores is also negative and there are two control variables, Size of Mall and Traffic People, whose estimated coefficients are statistically significant. As both coefficients are positive, we conclude that in average a bigger mall size and more traffic people impacts positively on the sales of non-anchor stores.

Table 15. Explaining the Sales of Non-Anchor Stores (random-effects regression)

Random-effects GLS regression		Number of obs =	105
Group variable (i): CC		Number of groups =	35
R-sq:		Obs per group: min =	3
within = 0.4076		avg =	3.0
between = 0.9194		max =	3
overall = 0.9109			
		wald chi2(11) =	392.90
Random effects u_i ~ Gaussian		Prob > chi2 =	0.0000
corr(u_i, X) = 0 (assumed)			

Total_Sa~NAS	Coef.	Std. Err.	z	P > | z |	[95% Conf.	Interval]
Type1	8731.311	8453.271	1.03	0.303	-7854.795	25281.42
Type2	-13596.01	11254.25	-1.21	0.227	-35653.93	8461.919
Type3	33448.46	6949.677	4.81	0.000	19827.35	47069.58
Type4	5685.237	1380.49	4.12	0.000	2979.526	8390.948
Type5	4954.691	4977.982	1.00	0.320	-4801.973	14711.36
Total_Sa~_AS	-.6111912	.0905112	-6.75	0.000	-.7885899	-.4337925
Size_Mall	1.072938	.253959	4.22	0.000	.5751875	1.570688
GLA_Anch	-20428.06	19595.92	-1.04	0.297	-58835.35	17979.23
FractionSp~h	.5100753	.647512	0.79	0.431	-0.759025	1.779176
Traffic_Pe~e	.0026431	.0005559	4.75	0.000	.0015534	.0037327
SBR	14520.21	38641.62	0.38	0.707	-61215.97	90256.38
_cons	-11049.23	13443.11	-0.82	0.411	-37397.23	15298.77
sigma_u	12832.716					
sigma_e	5709.0504					
rho	.83477999	(fraction of variance due to u_i)				

In the next step we examine the implications of these findings in terms of the rents of non-anchor stores.

6.2.3 Explaining the Rents of Non-Anchor Stores

The generation of externalities carries implications not only for the rents paid by non-anchor stores, but also for those paid by anchors. Supposedly, anchor (should) receive rent discounts in order for their externalities to be internalized. So, in this third step we test the effect of anchors on non-anchor stores rent. For that the dependent variable, rents of non-anchor stores, was modeled as a function of the same previously control variables specified in Table 13.

Table 16. Dependent (D) and Explanatory (E) Variables (Rents)

Variables	**Description**
Rent~NAS	Rent of Non-Anchor Stores, in € (D: explaining the rents of non-anchor stores)
Type1	Number of Large Anchor Stores (E)
Type2	Number of Unit Anchor Stores (E)
Type3	Number of Restaurants Anchor Stores (E)
Type4	Number of Cinema Anchor Stores (E)
Type5	Number of Leisure Anchor Stores (E)
Total_Sa~AS	Total Sales of Anchor Stores, in € (E)
Size_Mall	Store Size, measured by the stores total sales surface, in m^2 (E)
GLA_Anch	Gross Livable Area of Anchor Stores, which is the size of trade area, in m^2 (E)
FractionSp~h	Size of anchor divided by the total size of the center, in % (E)
Traffic_Pe~e	Number of people who visited the center (E)
SBR	Store Brand Recognition, measured by the number of times the same store appears in all centers divided by the total number of different anchor stores, in % (E)

Basically, as our main purpose is to check how the anchor stores impact on the rents of non-anchor stores, we included several control variables on the regression model to see if these variables offset the impact of the anchor stores.

Our dataset contains 105 “observations”, which is 35 commercial centers each one observed, on average, on 3 different years. An observation in our data is a commercial center in a given year.

To properly identify the best model to estimate we use the Breusch and Pagan (1980) test to choose between the pooled regression and the random-effects regression, and then the Hausman (1978) test to choose between the random-effects regression and the fixed-effects regression. The pooled regression hypothesis was rejected [$\chi_1^2 = 22.94$; p<0.001], and the random-effects hypothesis was not rejected [$\chi_4^2 = 6.43$; p=0.1691].

(Appendix 11 and 12) Thus, based on these results, we run random effects regressions[25]. The obtained results are presented in Table 17.

Table 17. Explaining the Rents of Non-Anchor Stores

Random-effects GLS regression	Number of obs =	105
Group variable (i): CC	Number of groups =	35
R-sq:	Obs per group: min =	3
within = .0490	avg =	3.0
between = 0.9610	max =	3
overall = 0.9504		
	wald chi2(11) =	658.22
Random effects u_i ~ Gaussian	Prob > chi2 =	0.0000
corr(u_i, X) = 0 (assumed)		

Total_Rent~NAS	Coef.	Std. Err.	z	P > | z |	[95% Conf.	Interval]
Type1	244.6909	695.1988	0.350	0.725	-1117.874	1607.256
Type2	-1595.267	946.557	-1.690	0.092	-3450.485	259.9509
Type3	2094.031	635.6293	3.29	0.001	848.2208	3339.842
Type4	202.009	128.5291	1.57	0.116	-49.90347	453.9214
Type5	705.7327	467.9653	1.51	0.132	-211.4625	1622.928
Total_Sa~_AS	.0040594	.0093365	0.43	0.664	-.0142397	.0223585
Size_Mall	.0499472	.0212281	2.35	0.019	.0083408	.0915535
GLA_Anch	.1660544	.0541468	3.07	0.002	.0599285	.2721802
FractionSp~h	-3823.261	1596.404	-2.39	0.017	-6952.155	-694.3676
Traffic_Pe~e	.0002664	.0000543	4.91	0.000	.0001601	.0003727
SBR	-1959.364	3131.471	-0.63	0.532	-8096.934	4178.207
_cons	874.7036	1085.472	0.81	0.420	-1252.781	3002.189
sigma_u	1093.8358					
sigma_e	688.68852					
rho	.71612354	(fraction of variance due to u_i)				

As one can see, the model is statistically significant (as the probability associated with the chi2 test is 0.000) and the overall R^2 is equal to 0.9504, a value that is also statistically significant due to the chi2 test result.

[25] To estimate the corresponding random-effects model, we apply the *xtreg, re* STATA's cross-sectional time-series regression command.

Based on *t*-test results, we can conclude that five estimated coefficients are statistically significant: the ones associated with the variables "Type 3", "Size of Mall', "GLA of Anchor Stores", "Fraction Space of Anchor Stores", and "Traffic People". All of them, except the "Fraction Space of Anchor Stores", have a positive sign. As the sign of the estimate is positive, the variables tend to vary in the same direction. This means that, on average, an additional Type 3 anchor store in one commercial center induces an increase (*ceteris paribus*) of €2094.031 on the rents of the non-anchor stores; on average, an additional square meter in the GLA of Anchor Stores and a one unit change in the Size of Mall leads to a change (*ceteris paribus*) of €.1660544 and €.0499472 on rents of non-anchor stores, respectively; and finally, on average, a one unit change in the Traffic People induces an increase (*ceteris paribus*) of €.0002664 on the rents of the non-anchor stores, supposing all the rest constant.

These results show that non-anchor stores pay more to be in bigger malls size and with larger anchors. Furthermore, Table 17 shows that non-anchor stores pay more to be with anchors of Type 3, which are exactly the anchor types shown to increase the sales of non-anchor stores the most (Table 15). Besides, the increase in non-anchor stores rents, stemmed by the presence of a larger number of traffic people, is consistent with the idea that high levels of customer traffic provides a large sales volume – agglomeration economies definition –, and therefore an increase in the amount of (overage) rent paid by stores increases (see, *e.g*., Gould *et al*., 2005).

As the "wrong" sign for the estimated coefficient of the Fraction Space of Anchor Stores, can be due to the multicollinearity problems, we estimate the model considering the Fraction Space of Anchor as the unique explanatory variable and the estimated coefficient remains negative.

6.2.4 The Efficient Allocation of a Commercial Center Space

An efficient allocation of a commercial center space is a crucial issue for mall developers interested in overall mall performance, yet, it is not straightforward. In fact, select retail stores and their locations in a profit-maximizing way remains a very complex task in the sense that it must take into account the connection between the externality-generating abilities of different store types and the rents they pay to the developer. However, a well-organized space planning can provide mall developers with a competitive edge.

The design of a shopping center can be viewed as a two-stage problem: the number and types of stores that the center will contain and the amount of space allocated to each of the chosen stores (Brueckner, 1993). Combining these insights with the carried out analysis, we verify that the increase of Type 3 and Type 4 anchors provide a greater amount of sales to non-anchor stores. Therefore, we confirm that leisure and entertainment areas have an increasingly greater role on the performance of a commercial center. Hence, developers must recognize that the attractiveness of the centers' stores to customers depends on those types of stores.

Besides, we concluded that Type 3 anchors positively influence non-anchor stores rent. So, this corroborates the previous idea of devoting more space to leisure areas.

The truth is that stores within a mall must be placed in relation to others to encourage multipurpose and comparative shopping throughout the facility. So, a perfect balance between internal competition and fulfilment of market needs is the key for the success.

7 CONCLUSION

Conventional wisdom suggests that cross-store effects may have a great impact on the performance of a commercial center. Few systematic analyses have been conducted, however, to verify such presence and magnitude. More importantly, neither the way these externalities affect the sales and rents of stores, nor how they should be translated into an efficient allocation of a commercial center space, are well understood. In an era where hyper competition at the store level prevails and 'high-order retailers'[26] receive incentives by paying lower rents per square meter, this fact leaves an important research area uncovered.

This thesis sheds some light on the issue. On the *conceptual side*, it identifies a set of potentially relevant spatial factors, including inter-store externalities, and uncovers the routes along which this last factor may impact store and mall performance. In doing so, we enhance the mall draw effect and also the consequences, in terms of sales and rents, that the condition of 'generator/receiver store' arises. Implicit in this scene stands the insights to achieve an efficient allocation of a commercial center space.

From a *methodological viewpoint*, we demonstrate that using a combination of cross section and time series data enables us to analyze those issues in a more accurate manner by identifying unobserved heterogeneity and revealing dynamics.

As previously stated, we intend to see how the Sonae Sierra's model responds to the conventional wisdom of those issues. The *empirical analysis* confirms that, on average, anchor stores have more space provided, higher volume of sales, and lower rents to pay. Specifically, Type 5 and Type 6 anchors are bigger in size and pay low rents. In addition, Type 6 and Type 4 seem to be the anchor stores that Sonae Sierra rely more on to establish the mall and generate externalities for other stores.

Having the privilege of multiple-period observations enables us to walk straight to the answers of the above mentioned issues. Hence, based on STATA® software tool, we identify that Type 4 anchors contribute to an increase on non-anchor sales and, deviating from previous researches, the total sales of anchor stores, as a whole, has a negative impact on non-anchor sales. This reveals some kind of substitution effect

[26] See Gatzlaff *et al*. (1994)

between anchor and non-anchor stores. Due to this unexpected result, and despite the Breusch-Pagan and Hausman tests results, we also estimate the random-effects regression model that shown that Type 3 anchors has also a positive impact on non-anchor stores sales as well as the Size of Mall and Traffic People.

Apart from that, we show that Type 3, the Size of Mall, the GLA of Anchor Stores, and the Traffic People provide an increase on non-anchor stores rent. Basically, we conclude that non-anchor stores pay more to be in bigger malls size and with larger anchors. Specifically, non-anchor stores pay more to be with anchors of Type 3, which are exactly the anchor types shown to increase the sales of non-anchor stores the most. Besides, the increase in non-anchor stores rent, stemmed by the presence of a larger number of traffic people, is consistent with the idea that high levels of customer traffic provides a large sales volume – agglomeration economies definition –, and therefore an increase the amount of (overage) rent[27] paid by stores increases.

These results allow us to confirm that, in part, Sonae Sierra's model is following the previous researches regarding the impact of anchor stores in the total sales and rents of non-anchor stores.

To analyze the problem of space allocation in shopping centers, focusing on inter-store externalities, we took into account the information extracted from the empirical analysis. Our results suggest that the presence of leisure and entertainment areas play a very important role in commercial center success, *i.e.*, to trigger the customer drawing power. In other words, Sonae Sierra shopping centers, aside from the main function of selling goods, now stands as 'small cities' where people go to socialize, stroll around and spend their free time. Also the analysis corroborates this idea by showing that Type 3 and 4 anchors (Restaurant and Cinema) provide an increase on non-anchor store sales and, the former, also on non-anchor rents. Therefore, in order to achieve a perfect balance between internal competition and fulfilment of market needs, mall developers must devote more space to leisure areas.

Due to the confidentiality of information, no research outside the company itself has made use of Sonae Sierra data so far. Thus, the current study stands to act as a palpable contribution to empirical research on the outcomes achieved by shopping centers as well as a springboard for the elaboration of other studies.

[27] Overage rent is defined as the part of the rent that depends on sale.

Clearly, our thesis has a number of limitations. The dataset is fairly restrictive, in the sense that it only considers Sonae Sierra shopping centers. Hence, the results can only be generalized using this model as a basis. Other limitations were our inability to gather data on customer purchasing power in the areas surrounding the Sonae Sierra shopping centers. Future research may benefit from adding a number of control variables characterizing the market areas of the different malls, as well as other overall mall characteristics (such as, for instance, leisure areas). Also, analyzing whether Sonae Sierra's strategy is to build or buy malls in locations where customer purchasing power is fairly homogeneous may lead to refined conclusions. A final caveat is concerning to the need to safeguard the confidentiality of the information, which kept us from using more independent variables in our models.

In short, much more needs to be done to deeply understand the real implication of inter-store externalities on space allocation and, therefore, the performance of a commercial center. To assess not only positive, but also negative externalities between stores may be a fruitful area for future research. To quantify externalities between different types of stores in a mall allowing for positive as well as negative externalities, and externalities flowing from the anchor store to other stores as well as vice-versa, may reveal important issues never considered before.

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9 APPENDICES

Appendix 1. GLA of Anchor and Non-anchor Stores

Types of Stores	GLA (m^2)	Percent
Anchors	506,954.46	42.2%
Non-Anchors	695,503.69	57.8%
Total	**1,202,458.15**	**100%**

Appendix 2. Mean Sales of Anchor and Non-anchor Stores

Types of Stores	Total Sales 000 (€)	Number of Stores	Sales per Store	Percent
Anchor	3,420,518.931	170	20,120.69959	93.4%
Non-Anchor	5,301,590.104	3,752	1,413.003759	6.6%
Total	**8,722,109.035**	**3,922**	**21,533.70335**	**100%**

Appendix 3. Base and Overage Rent of Anchor Stores

Rent of Anchor Stores	Value (€)	Percent
Base	127,417,683.6	91.4%
Overage	12,030,537.69	8.6%
Total	**139,448,221.3**	**100%**

Appendix 4. Base and Overage Rent of Anchor Stores in 2005

Rent of Anchor Stores ‘05	Value (€)	Percent
Base	35,131,891.05	90.3%
Overage	3,762,815.25	9.7%
Total	**38,894,706.3**	**100%**

Appendix 5. Base and Overage Rent of Anchor Stores in 2006

Rent of Anchor Stores ‘06	Value (€)	Percent
Base	44,835,946,7	91.5%
Overage	4,157,436,58	8.5%
Total	**48,993,383,28**	**100%**

Appendix 6. Base and Overage Rent of Anchor Stores in 2007

Rent of Anchor Stores '07	Value (€)	Percent
Base	47,449,845.87	92.0%
Overage	4,110,285.86	8.0%
Total	**51,560,131.73**	**100%**

Appendix 7. Types of Anchor Stores

Types of Anchor Stores	Frequency	Percent
Type 1	132	77.6%
Type 2	6	3.5%
Type 4	14	8.2%
Type 5	3	1.8%
Type 6	15	8.8%
Total	**170**	**100%**

Appendix 8. Brands per Type of Anchor Stores

Stores' Brand	Frequency	Percent
Type 1	34	73.91%
Type 2	3	6.52%
Type 4	3	6.52%
Type 5	2	4.35%
Type 6	4	8.70%
Total	**46**	**100%**

STATA® can perform the Breusch and Pagan Lagrange multiplier test to choose between pooled regression and the random-effects regression:

Appendix 9. Breusch-Pagan Test (Sales)

Breusch and Pagan Lagrangian multiplier test for random-effects:

Total_SalesNAS[CC, t] = xb + u [CC] + e[CC, t]

Estimated results:

	var	sd = sqrt (var)
Total~NAS	3.18E+09	56434.53
e	2.26E+07	5709.05
u	1.65E+08	12832.72

Test: var(u) = 0

chi2(1) = 29.28

Prob > chi2 = 0.0000

In addition, we perform the Hausman test, which compares the consistent fixed-effects model to the efficient random-effects model:

Appendix 10. Durbin-Wu-Hausman Test (Sales)

	Coeficients			
	(b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Type3	3306.784	33448.46	-30141.68	7006.963
Type4	5553.196	5685.237	-132.0411	1596.43
Type5	6663.393	4954.691	1708.702	4774.125
Total_Sa~_AS	-.6760964	-.6111912	-.0649052	.
GLA_Anch	2.080412	.5100753	1.570336	1.473009
FractionSp~h	-101829.9	20428.06	-81401.84	59967.12
Traffic_Pe~e	.0002499	.0026431	-.0023932	.000171

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: different in coefficients not systematic

chi2(4) = (b-B)' [(V_b-V_B)^(-1)] (b-B)

=30.39

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Appendix 11. Breusch-Pagan Test (Rents)

Breusch and Pagan Lagrangian multiplier test for random-effects:

RentNAS[CC, t] = xb + u [CC] + e[CC, t]

Estimated results:

	var	sd = sqrt (var)
Ren~S	3.62E+07	6016.434
e	474291.9	688.6885
u	1196477	1093.836

Test: var(u) = 0

chi2(1) = 21.72

Prob > chi2 = 0.0000

Appendix 12. Durbin-Wu-Hausman Test (Rents)

	Coeficients			
	(b) fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Type3	1244.031	2094.031	-850.0009	1006.608
Type4	-63.59052	202.009	-265.5995	219.7707
Type5	-603.5984	705.7327	-1309.331	687.9513
Total_Sa~_AS	-.0107149	.0040594	.0147743	.00285
GLA_Anch	-.0299067	.1660544	-0.1959611	.1863953
FractionSp~h	77103.475	-3823.261	10926.74	7441.01
Traffic_Pe~e	.0000872	.0002664	-.0001792	.0000445

b = consistent under H_o and H_a; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: different in coefficients not systematic

chi2(4) = (b-B)' [(V_b-V_B)^(-1)] (b-B)

=8.39

Prob>chi2 = 0.1721

(V_b-V_B is not positive definite)